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(54) **PREPARATION AND MAINTENANCE OF SENSORS**

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(60) Provisional application No. 60/990,797, filed on Nov. 28, 2007.

(51) **Int. Cl.**

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C12Q 1/00	(2006.01)
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(52) **U.S. Cl.**

CPC ***G01N 27/327*** (2013.01); ***G01N 33/4875*** (2013.01); *A61B 2562/242* (2013.01); *A61B 5/1495* (2013.01); ***A61B 5/1486*** (2013.01); ***A61B 5/14532*** (2013.01)

USPC ... **205/777.5**; 205/792; 205/775; 204/403.01; 204/403.04

(58) **Field of Classification Search**

CPC G01N 27/3271–27/3278

USPC 204/403.01–403.15; 205/775, 792, 777

See application file for complete search history.

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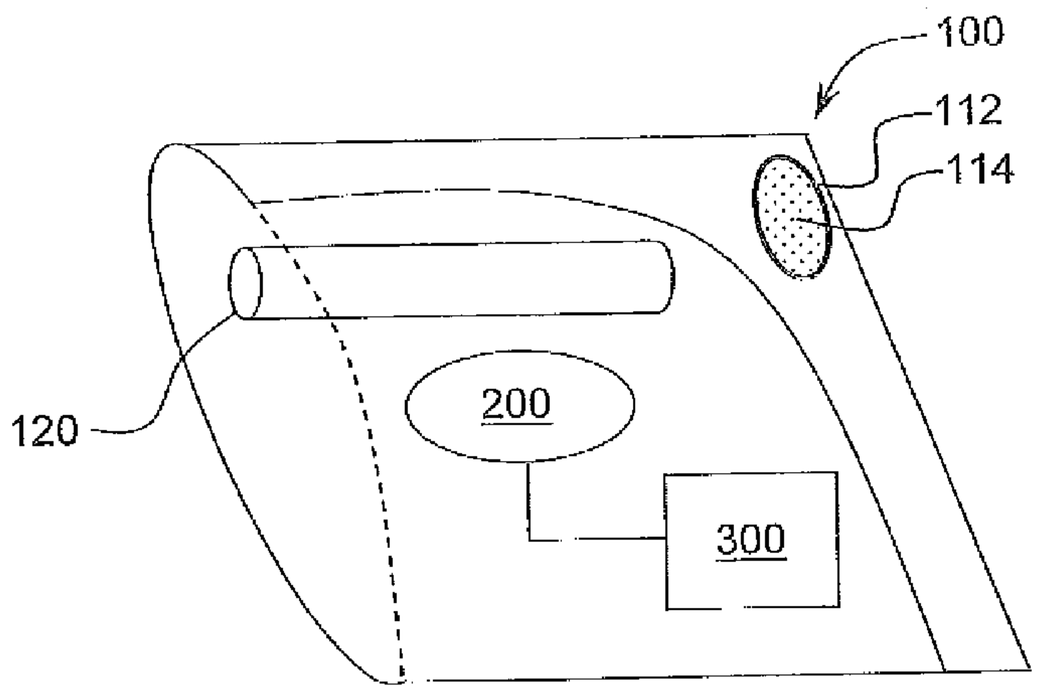
(57) **ABSTRACT**

Apparatus and methods are described for preparing, maintaining, and stabilizing sensors. The apparatus and methods for preparing sensors for use are utilized in advance of the sensor being removed from a sealed, sterilized package. The apparatus include packaging materials having electrical circuits capable of stabilizing a sensor to prepare the sensor for use. The methods for preparing a sensor for use includes methods of providing a solution to a sterilized packaging that contains a sensor connected to a sensor activating circuit, activating the circuit, and allowing the sensor to stabilize. These methods can be performed without compromising the packaging. The apparatus for stabilizing a sensor that is in use include a circuit connectable to the sensor that provides a signal to the sensor that prevents the sensor from becoming destabilized when disconnected from a monitoring device.

7 Claims, 5 Drawing Sheets



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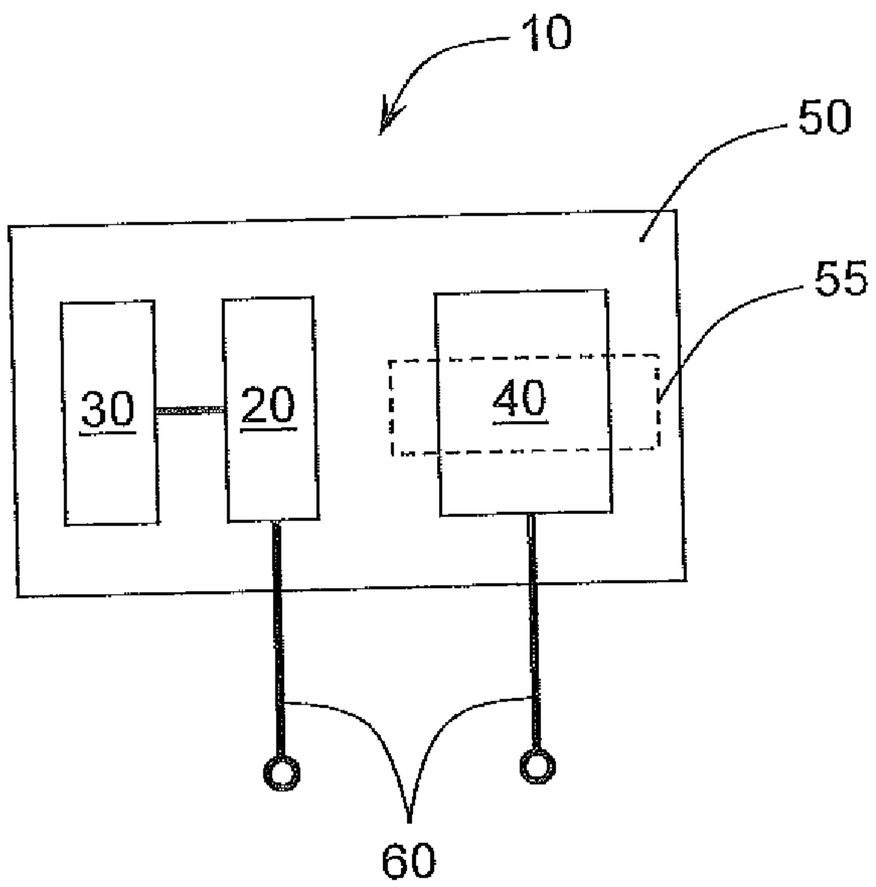

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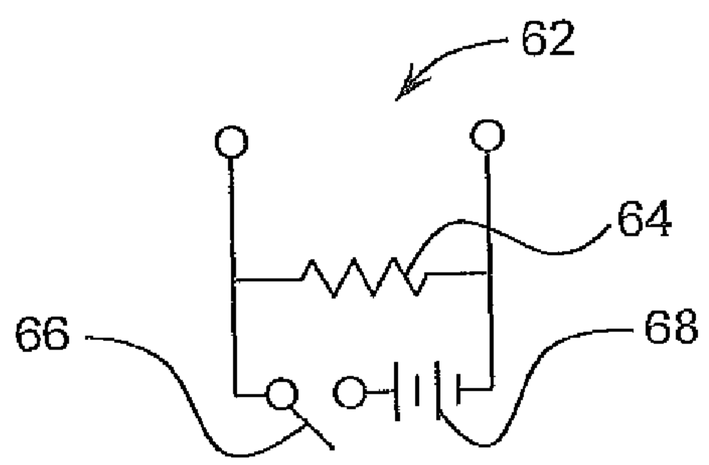

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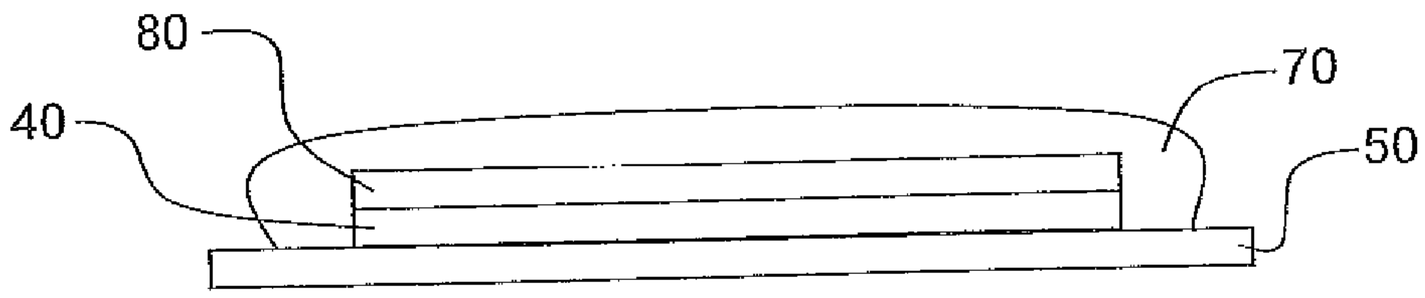

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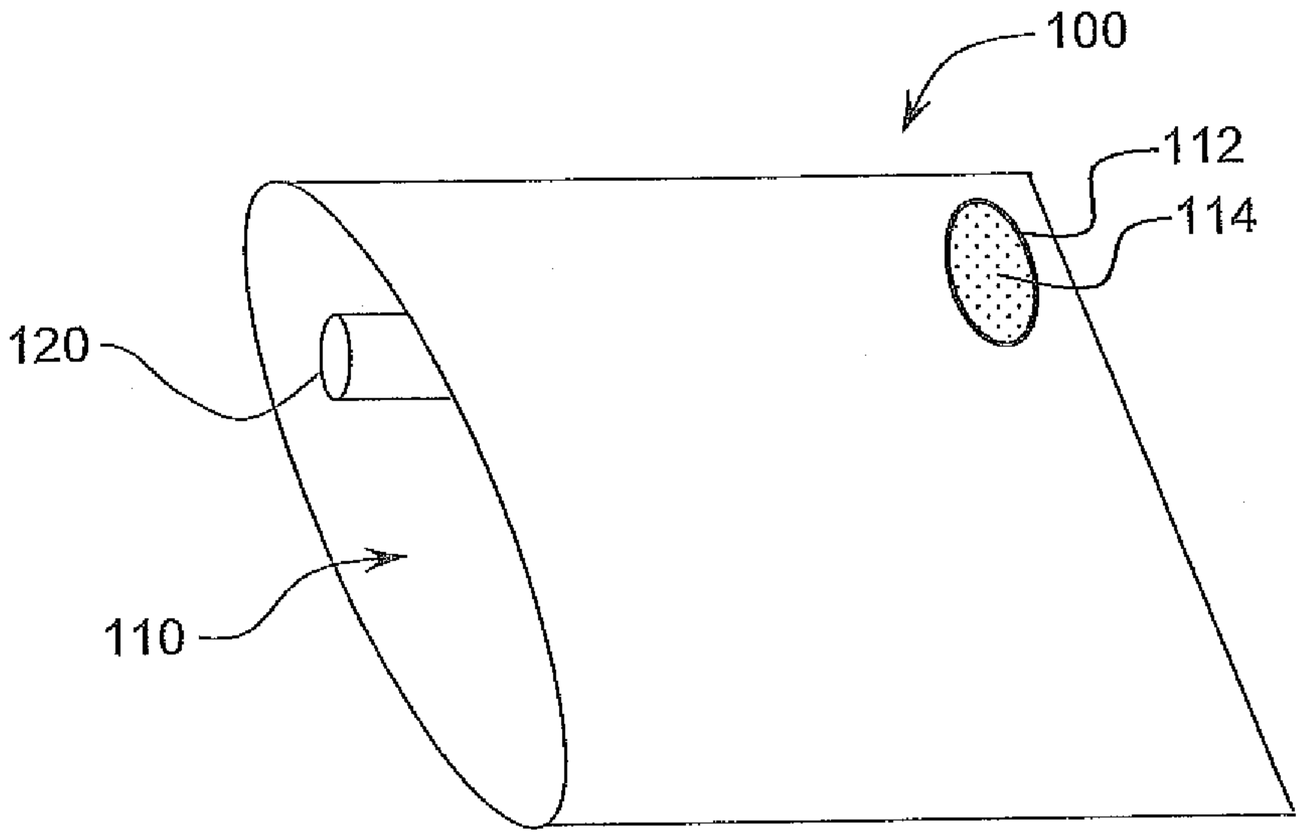

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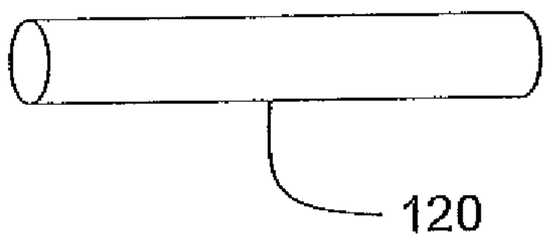

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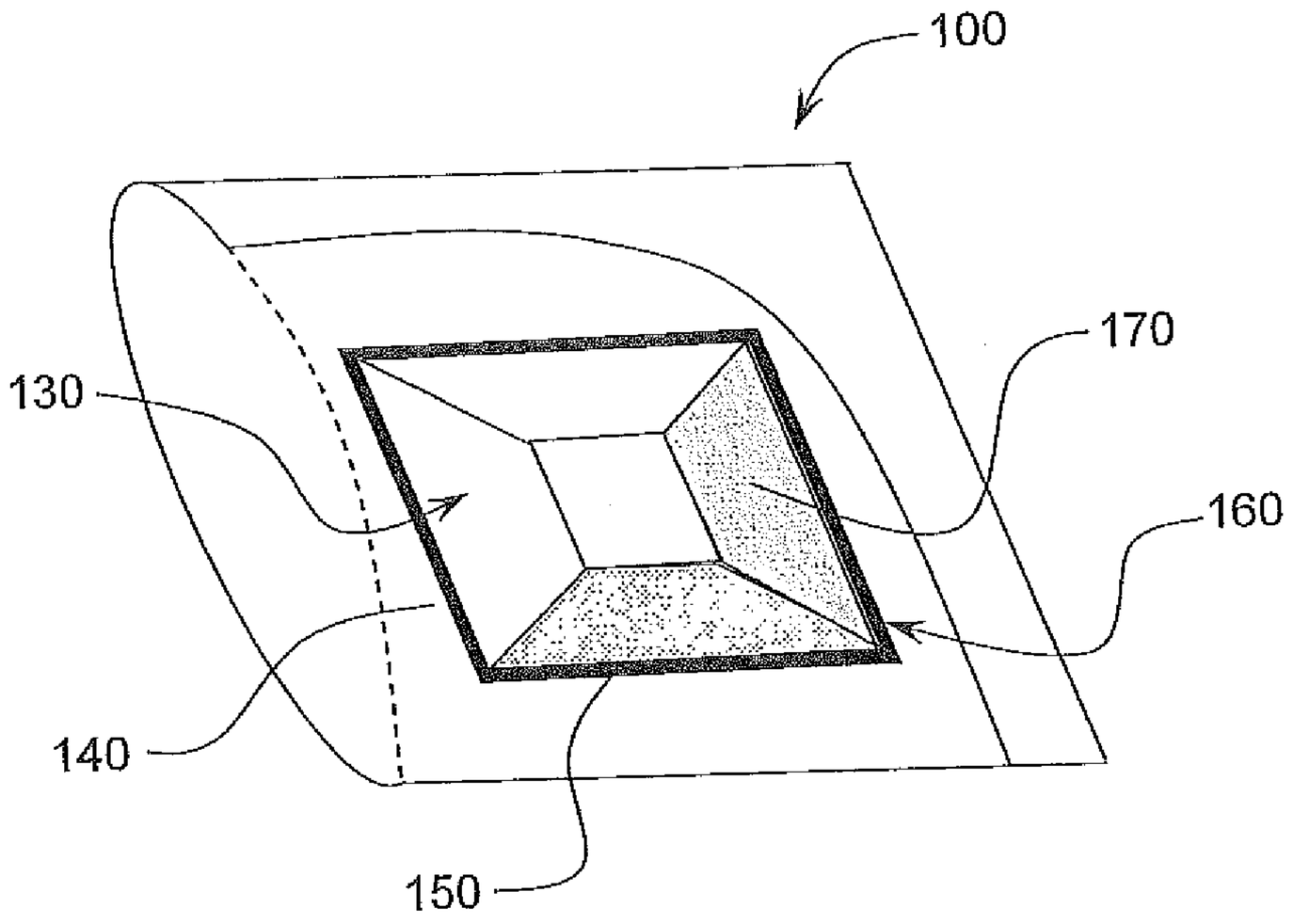

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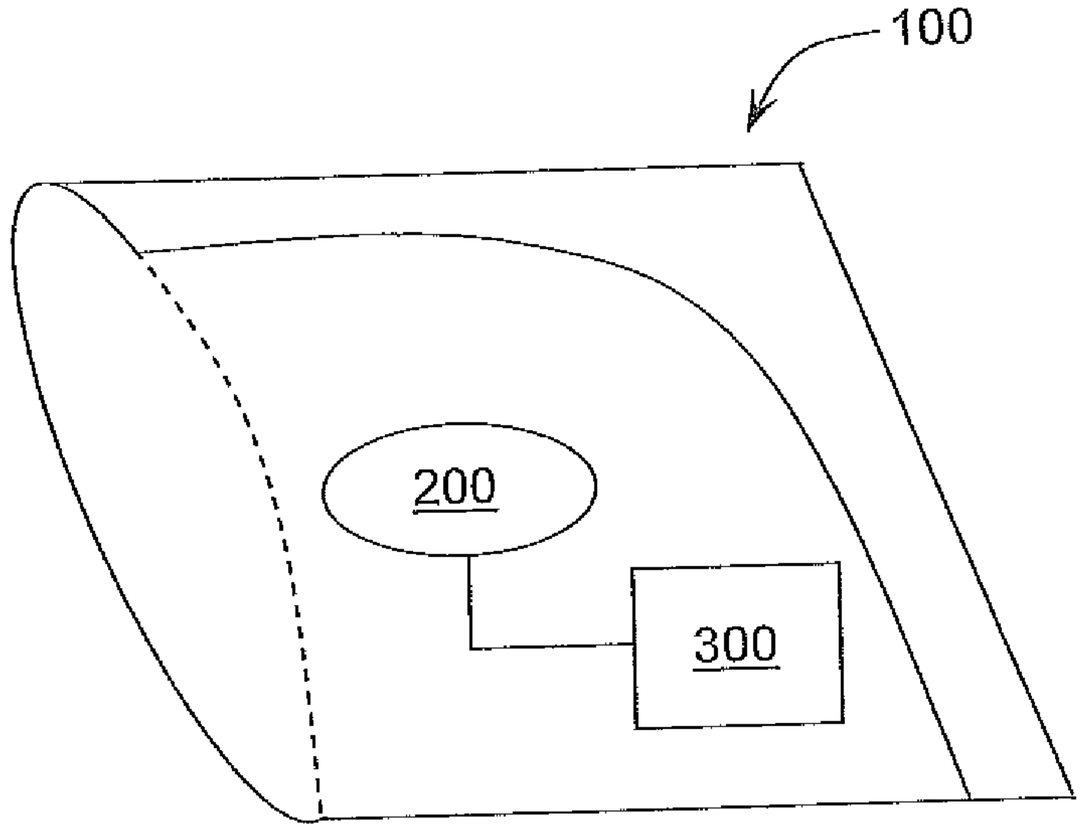

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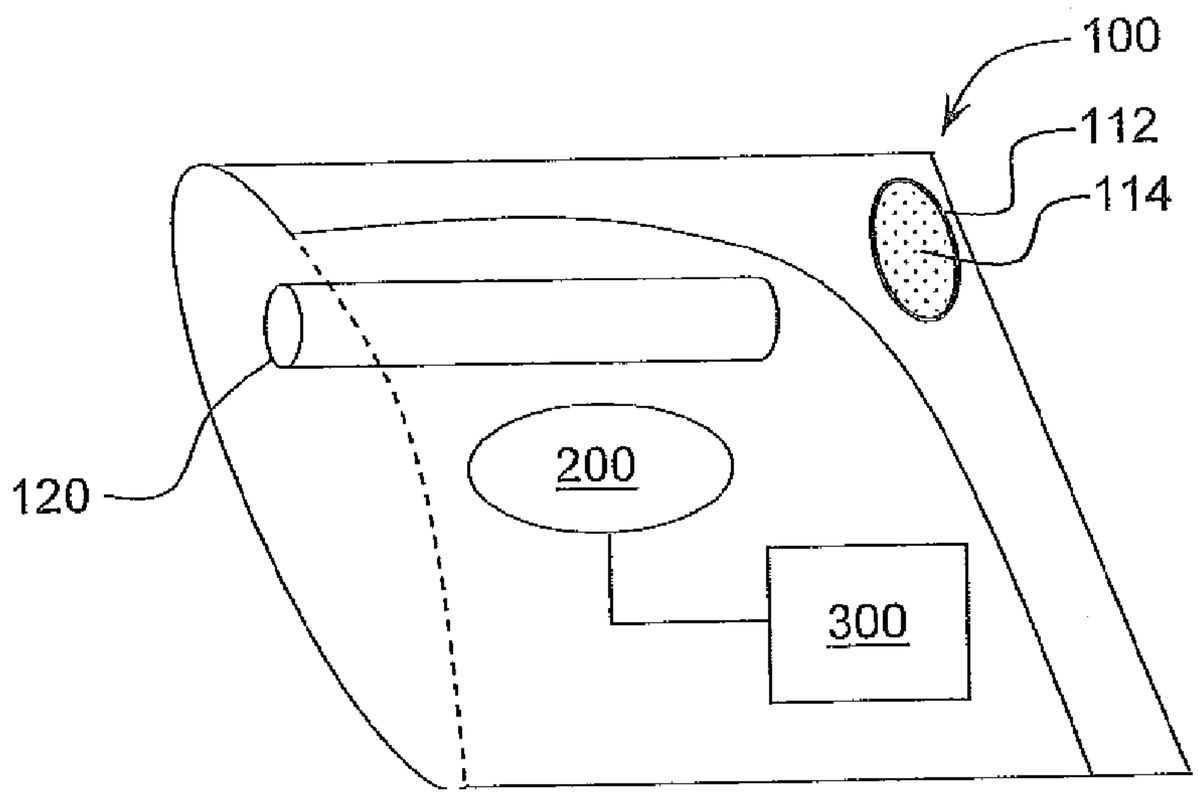

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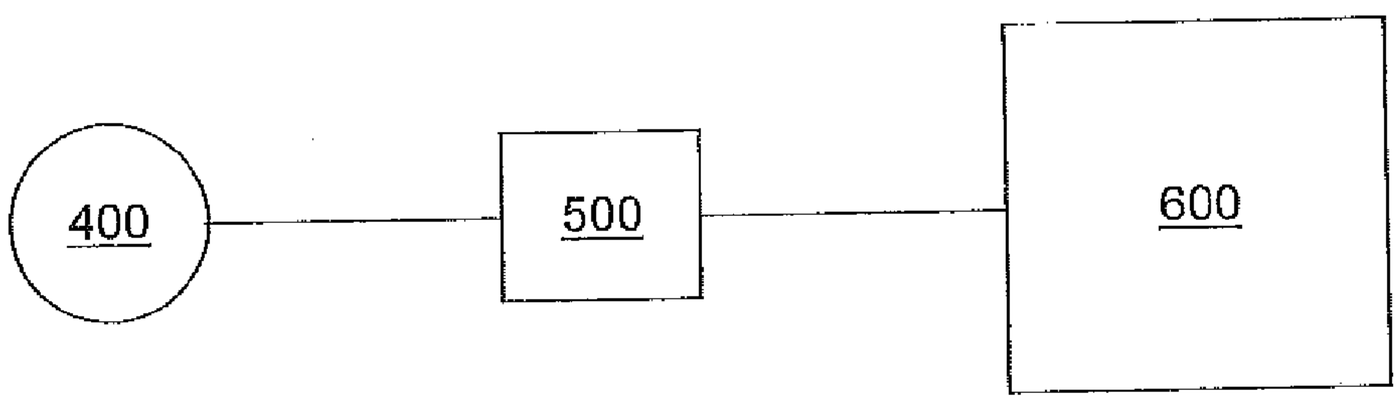

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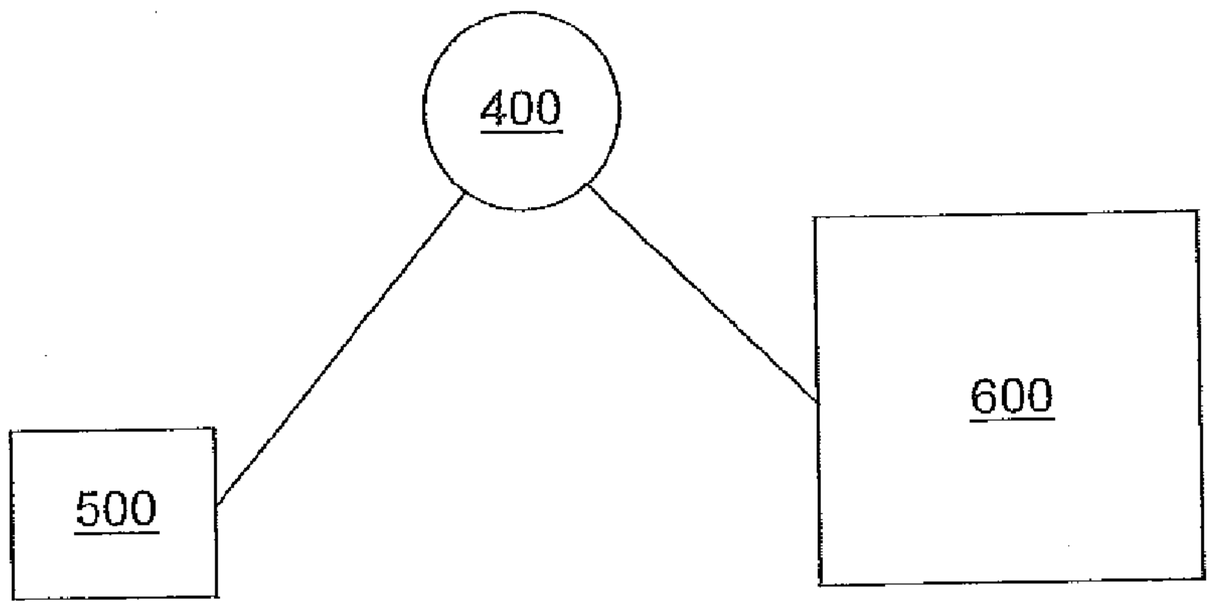


Fig. 9

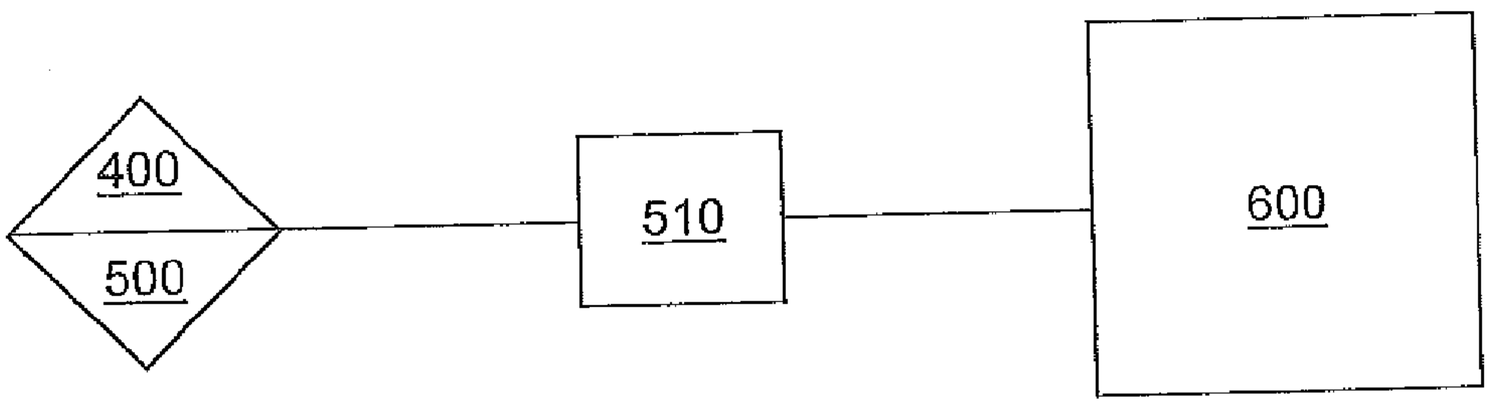
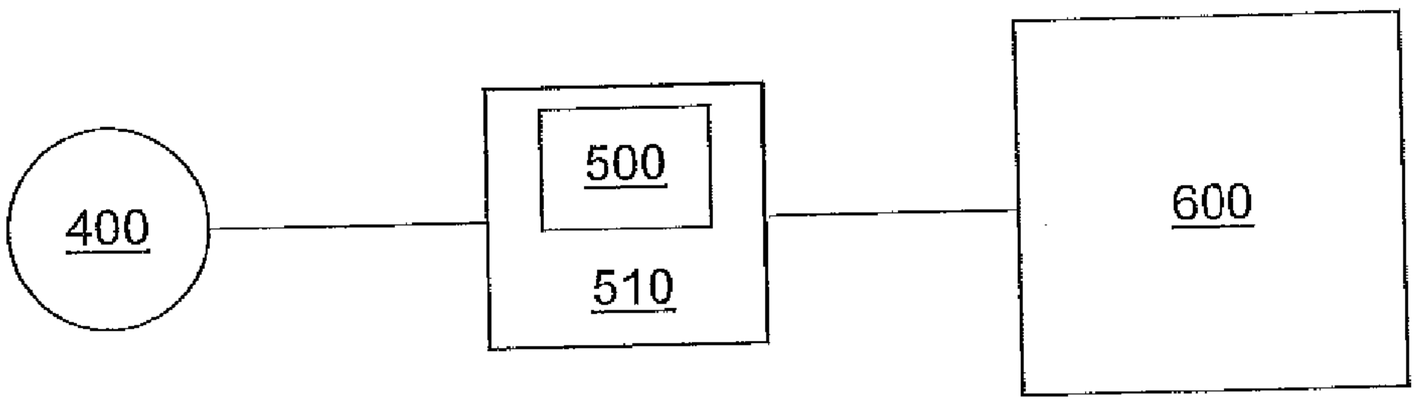


Fig. 10



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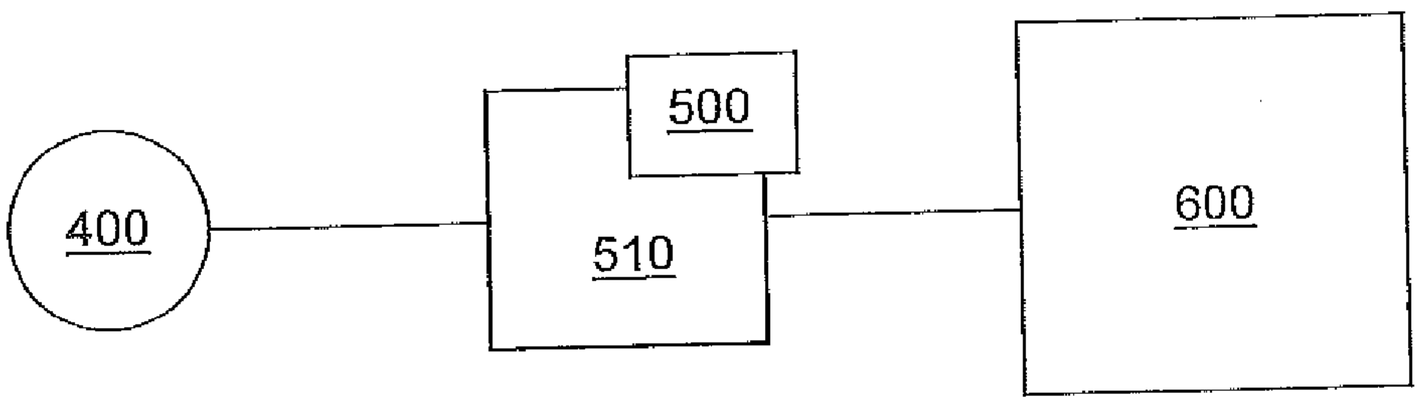

Fig. 12

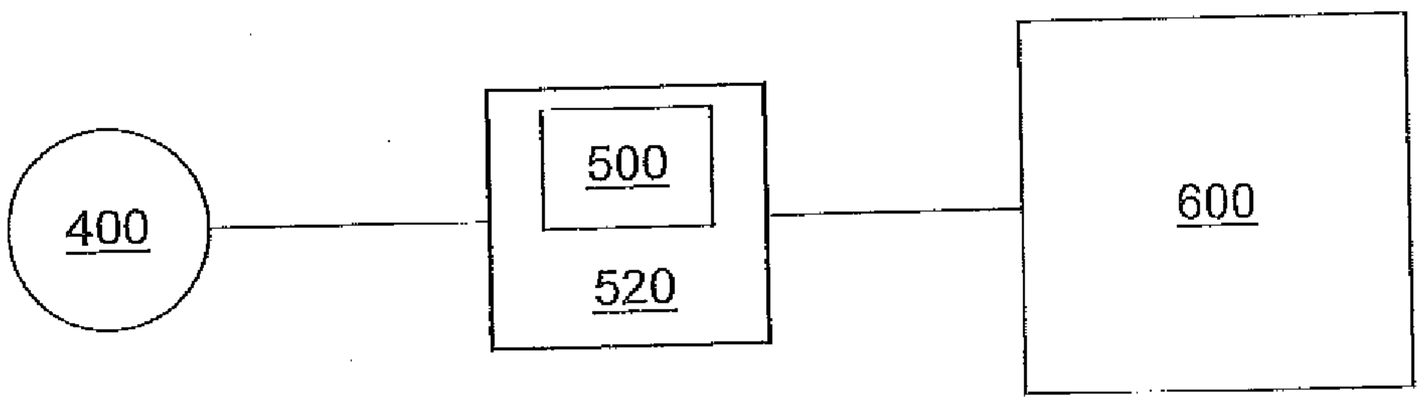

Fig. 13

PREPARATION AND MAINTENANCE OF SENSORS

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 12/276,230 filed Nov. 21, 2008 and claims priority from U.S. provisional patent application No. 60/990,797, filed on Nov. 28, 2007, which is also hereby incorporated herein by reference.

BACKGROUND

Before some sensors are capable of making their intended measurements, they go through some form of conditioning. The time it takes a sensor to be conditioned and become capable of making measurements is often referred to as its run-in period. Run-in periods can last for as little as a few minutes to as long as a few days. The type of conditioning and run-in time required for each type or kind of sensor will vary depending on the condition of the sensor and the intended purpose and design of the sensor being used. For example, electrochemical sensors often contain electrodes at which electrochemical reactions take place, an electrolytic solution or transport matrix in which the reactions take place, and a membrane to control the access of analyte species. Examples of the types of conditions that control the length of run-in time include the time it takes for the appropriate oxidation or reduction of chemical species at the electrodes before the desired reactions to take place, the consistency of the electrolytic solution or transport matrix, and the hydration of the membrane. Regardless of the type of conditioning required for a particular sensor, a sensor sealed within a container without access to required compounds or signals cannot undergo run-in conditioning.

SUMMARY

Apparatus and methods for preparing and maintaining sensors, such as electrochemical sensors, are disclosed. The apparatus and methods for preparing sensors are utilized in advance of the sensor being removed from a sealed sterilized package. The apparatus for preparing sensors include packaging materials incorporating electrical circuits capable of exciting or stabilizing a sensor. The methods for preparing sensors include methods of providing a solution to a sterilized packaging containing a sensor connected to a sensor activating circuit without compromising the sterilizable packaging, activating a circuit electrically connected to the sensor, and allowing the sensor to stabilize. The providing and activating steps preferably occur without breaching the sterilized packaging.

Further disclosed are apparatus for stabilizing a sensor that is in use. These apparatus include a circuit connectable to the sensor that provides a signal to the sensor that prevents the sensor from becoming destabilized when disconnected from a monitoring device. Such a circuit can prevent a sensor from becoming depolarized by, for example, providing an appropriate electrical current or potential. These apparatus can also include a rechargeable voltage source and/or a recordable storage medium that is capable of recording data related to a sensor.

DESCRIPTION OF DRAWINGS

FIG. **1** is an illustration of an electrochemical sensor.

FIG. **1**A is a schematic of a circuit.

FIG. **2** is a cross-sectional view of the working electrode of the electrochemical sensor of FIG. **1**.

FIG. **3** is a perspective view of a sterilizable packaging in the form of a sealable pouch.

FIG. **4** is a rupturable solution container in the shape of a cylinder.

FIG. **5** is a cut away view of a sealable pouch with an alternative embodiment of a rupturable solution container that is partially formed using the back portion of the sealable pouch.

FIG. **6** is a cut away view of a sealable pouch containing a sensor connected to a circuit capable of exciting the sensor.

FIG. **7** is a cut away view of a sealable pouch containing a sensor connected to a circuit capable of exciting the sensor and a rupturable solution container.

FIG. **8** is a block diagram showing a configuration of a sensor connected in series to a circuit then to a monitoring device.

FIG. **9** is a block diagram showing an alternative configuration of the circuit connected to the sensor and monitoring device connected to the sensor not in series.

FIG. **10** is a block diagram showing an alternative configuration with the circuit and the sensor integrated into a single unit and connected to a patient monitoring cable and a monitoring device in series.

FIG. **11** is a block diagram showing an alternative configuration with the circuit integrated into a patient monitoring cable such that the circuit is not removed when the sensor is in use.

FIG. **12** is a block diagram showing an alternative configuration with the circuit removeably connectable to a patient monitoring cable.

FIG. **13** is a block diagram showing an alternative configuration with the circuit housed in a module to which the sensor and monitoring device can be connected.

Like reference numerals and symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

Apparatus and methods for preparing and maintaining sensors for use are disclosed herein. The apparatus and methods for preparing sensors for use are utilized in advance of the sensor being removed from a sealed sterilized package. The apparatus include packaging materials having electrical circuits capable of stabilizing a sensor to prepare the sensor for use. The methods for preparing a sensor for use include methods of providing a solution to a sterilized packaging that contains a sensor and activating a circuit electrically connected to the sensor. These methods can be performed without compromising the sterilized packaging and allow time for the sensor to stabilize.

Further disclosed herein are apparatus for stabilizing a sensor that is in use. These apparatus include a circuit connectable to the sensor that provides a signal to the sensor that prevents the sensor from becoming destabilized when disconnected from a monitoring device. A circuit for stabilizing a sensor during use can be similar to or the same as a circuit for preparing a sensor for use.

As shown in FIG. **1**, a sensor **10** for measuring an analyte includes a reference electrode **20**, an optional counter electrode **30**, and a working electrode **40** provided on a substrate **50**. The electrodes (**20**, **30**, **40**) are formed of a conductive material. The reference electrode **20** can be, for example, an Ag/AgCl electrode. The counter electrode **30** and working electrode **40** can be, for example, graphite and platinum. In operation, the reference electrode **20** establishes a fixed

potential from which the potential of the counter electrode **30** and working electrode **40** can be established. The counter electrode **30** provides a working area for conducting the majority of electrons from, for example, an oxidation reaction back to the solution being analyzed, i.e., blood. Otherwise the current generated from the chemical reaction would pass through the reference electrode **20** and possibly reduce its service life. Electrically conductive wires **60** are connected to the reference electrode **20** and working electrode **40** for applying and/or measuring current or potential at or between the electrodes. Although the sensor **10** shown in FIG. **1** includes one reference electrode **20**, one counter electrode **30**, and one working electrode **40**, electrochemical sensors can include multiple reference electrodes, counter electrodes, and working electrodes as would be understood by one of skill in the art.

The electrically conductive wires **60** can be connected to a circuit. An example of a circuit **62** is shown in FIG. **1**A. A circuit **62** can include a parallel resistor **64** to limit voltage drop, a switch **66**, and a voltage source **68** such as a battery, as shown in FIG. **1**A. Such a circuit **62** can be a current controlled voltage source that provides a constant voltage. An example of a range of voltages for use in such a circuit **62** is about 0.2 V to about 2 V, other ranges of voltages include about 0.4 V to about 1.5 V, about 0.5 V to about 1 V, and about 0.6 V to about 0.7 V. Other circuit designs that provide a current controlled voltage source that provides a constant voltage will be apparent to one of skill in the art. For example, other electrical components can be used instead of or with the parallel resistor **64** such as a capacitor to help control the voltage of the circuit.

FIG. **2** shows a cross-section of the area enclosed by the dashed area **55** in FIG. **1**. In FIG. **2**, the working electrode **40** is covered by an analyte selective membrane **70** which also covers a reagent layer **80**. Reagent layer **80** is selected to react with one or more specific analytes found or expected to be found in a fluid to be analyzed. For example, in a glucose biosensor, the reagent layer **80** can contain glucose oxidase, such as may be derived from *Aspergillus niger* (EC 1.1.3.4), type II or type VII. Reagent layer **80** can also include a matrix such as a hydrogel to promote a reaction between the reagent and an analyte that passes through the membrane **70**. A hydrogel, for example, can be water absorbent and swell to provide active transport of an analyte in a fluid under analysis (e.g., glucose) from the fluid into the reagent layer **80**.

An apparatus for preparing a sensor for use in advance of the sensor being removed from a sealed sterilized package is shown in FIG. **3**. FIG. **3** is a perspective view of a sterilizable packaging in the form of a sealable pouch **100**. Although FIG. **3** illustrates a sealable pouch **100**, any other form of sterilizable packaging can be used in accordance with the invention. The sealable pouch **100** is made of a material such as a polymer that can maintain a sterilized environment and is typically liquid and vapor impermeable. The sealable pouch **100** is referred to as being sealable rather than sealed because, as depicted, one end **110** is open. The sealable pouch **100** can be sealed using an adhesive composition or heat sealing (melting) in the case of a polymer. Techniques for sealing sterilized containers are well known to those of skill in the art. The sealable pouch **100** can be made from flexible materials or a mixture of flexible, rigid, or substantially rigid materials. For example, the sealable pouch could include a rigid back portion, i.e., a rigid backing, and a flexible front portion.

Also shown in FIG. **3** is a resealable portion **112**. The resealable portion **112** can be used to provide solution to the sealable pouch **100**. The resealable portion **112** can for example be a self-sealing membrane **114** through which a syringe can be inserted. Alternatively, or in addition to the resealable portion **112** is shown a partial view of a rupturable solution container **120** that is inserted into the sealable pouch **100**. The rupturable solution container **120** is also shown in FIG. **4**. As shown, the rupturable solution container **120** is cylindrical, though other shapes and configurations are possible. Additionally, the size of the rupturable solution container **120** can be varied to accommodate the volume of solution desired to be delivered to the sealable pouch **100**.

The rupturable solution container **120** is made from a material, such as a polymer, that is more easily ruptured than the material used to make the sealable pouch **100**. A more easily ruptured material is used so the rupturable solution container **120** can be ruptured while on the interior of the sealable pouch **100** using forces that will not breach the sealable pouch **100**. For example, the sealable pouch **100** will not be breached at any point along the material used to form the sealable pouch **100** or any point where two or more portions of the sealable pouch **100** are sealed together, e.g., along a seam, when the rupturable container is ruptured. The ability to maintain the integrity of the sealable pouch **100** allows the maintenance of a sterilized state for any contents of the sealable pouch **100**. The rupturable solution container **120** can be attached to an inner portion of the sealable pouch **100** through the use, for example, of an adhesive or by forming the rupturable solution container as part of the sealable pouch. Attaching the rupturable solution container **120** to an inner portion of the sealable pouch **100** can provide consistency in the positioning of the rupturable solution container **120** for ease of use. The terms rupture and breach and their derivatives are used herein to indicate that a container has been opened such that the contents of a container are able to move from the interior of the container to the exterior of the container. It is noted that the solution can be provided in the rupturable solution container **120** when the sealable pouch **100** is sealed and shipped and/or stored, or the sealable pouch can be sealed and the rupturable solution container filled through the use of a resealable portion **112** and a syringe as discussed above.

An alternative design for the rupturable solution container **130** is shown in FIG. **5**. In FIG. **5**, a rupturable solution container **130** is shown in which a portion of the rupturable solution container **130** is formed by an interior surface **140** of the sealable pouch **100**. A seal **150** between the perimeter **160** of the rupturable solution container **130** and the interior surface **140** of the sealable pouch **100** attaches the rupturable solution container **130** to the interior surface **140** of the sealable pouch **100** and prevents solution from leaking prematurely from the rupturable solution container **130**. In this embodiment of a rupturable solution container **130**, the more easily ruptured material is used to form the interior side **170** of the rupturable solution container **130**, which ruptures prior to a breach of the material used to form the sealable pouch **100** to allow the solution into the sealable pouch **100**.

The types of polymers or other materials for use in such containers can include, for example, polypropylene or polyethylene film or sheet. The tear strength, i.e., the resistance of a material to tear forces (as might be measured by ASTM D 1922), is a relevant property for the apparatus and methods described herein. For example, the relative tear strengths of the materials used for the rupturable solution container **120** and the sealable pouch **100** are important in determining the material for use as the rupturable solution container **120** in that the tear strength of the material for use as the rupturable solution container **120** will be less than the tear strength of the sealable pouch **100**.

The sealable pouch **100** described herein can be used to contain a sensor such as an electrochemical sensor. An

example of an electrochemical sensor is a blood glucose sensor. The run-in period for a sensor located in a sealable pouch **100** as described herein that has a sensor sealed inside can be begun by providing an electrolytic, i.e., conductive, solution to the sealable pouch **100**. The electrolytic solution can be medically safe and non-toxic, e.g., sterile saline. The electrolytic solution can be provided from an external source or contained, for example, in a rupturable solution container **120**, which can provide solution to the sealable pouch **100** when ruptured. As used herein, run-in time is the time it takes for the sensor to reach equilibrium and to be ready for measurement. Once the electrolytic solution is provided or the rupturable solution container **120** is breached, the solution can spread into the sealable pouch **100** and contact the sensor. Electrolytic solution can be provided, for example, by introducing a solution through a resealable portion of the sealable pouch, such as, for example, by injection through the resealable membrane **114**.

Once contacted by the solution, the run-in period can begin with respect to, for example, hydration. Run-in time can be considered to include multiple phases such as hydration (i.e., the time for the sensor to come into contact and equilibrate with a solution) and polarization (i.e., the time for the sensor to stabilize once voltage is applied to the sensor). These phases can occur simultaneously or overlap. If aspects of the sensor other than hydration remain to be activated or run-in after exposure to the solution, such as aspects of the sensor that are dependent on the presence of an electric potential, these aspects for preparing the electrode can then be performed after the solution is added. If the circuit is connected to the sensor prior to the addition of solution, both hydration and electrical stabilization can begin as soon as the system comes into contact with the electrolytic solution. Electrical stabilization of the sensor can include non-Faradaic responses.

To run-in the electrical aspects of a sensor contained in a sealable pouch **100**, a sensor can be connected to a circuit designed to excite the sensor, such as, for example, the circuit shown in FIG. **1**A. As shown in FIG. **6**, a sensor **200** can be electrically connected to a circuit capable of exciting the sensor **300** with both the sensor **200** and circuit capable of electrically exciting the sensor **300** located within the sealable pouch **100**. The circuit **300** can be provided in the sterilized sealable pouch **100** and can be activated within the sealable pouch **100** without exposing the sensor **200** to the outside environment. The circuit capable of electrically exciting the sensor **300** can be manually activated through the use of a force external to the sealable pouch **100** such as by the activation of a switch, remotely activated through the use of an external signal, or automatically activated upon the provision of a solution to the sealable pouch **100**. For example, an electrical connection for activating the circuit **300** can be provided on a surface of the sealable pouch **100** and manually activated without opening the pouch or a complete circuit can be integrated into the sealable pouch **100** that is activated upon the provision of an electrolytic solution. As used herein, the phrase "excite the sensor" refers to providing an electrical signal to the sensor **200** such that the sensor achieves, remains at or close to, or approaches a condition at which it can take sensor readings with little or no additional electrical preparation. Such an electrical signal can include, for example, a current controlled constant or periodic potential provided by, for example, a current controlled voltage source that provides a constant voltage, which is applied to a reference electrode **12** and/or a working electrode **16** such as those shown in FIG. **3**. The number and type of electrical signals can depend on the number and state the electrodes will need to be in when the sensor **300** is used for sensing. FIG. **7** shows an embodiment in which a circuit capable of electrically exciting the sensor **300** and alternatively a resealable portion **112** and/or a rupturable solution container **120** are included in a sealable pouch **100**. In this embodiment, the circuit capable of electrically exciting the sensor **300** can be activated at or around the time the rupturable solution container **120** is ruptured through, for example, the use of a fluid sensor located within the pouch.

Methods for preparing a sensor for use include providing a solution such as an electrolytic solution to a sterilized packaging containing a sensor without compromising the sterilizable packaging then allowing the sensor to stabilize in the solution. The sensor can be connected to a sensor activating circuit before or after the provision of the electrolytic solution. If the sensor is connected to a sensor activating circuit after solution is provided, the sensor activating circuit can be activated and the electrical aspects of the system can be run-in. The circuit can be activated by an external force, such as moving a switch, or automatically when the solution is provided. For example, solution can be provided and a switch activated to initiate the sensor activating circuit. For further example, solution can be provided and the sensor activating circuit can be activated by the presence of solution. Such sensors are described above and can include a glucose sensor. Examples of solutions for use with the apparatus and methods herein include, but are not limited to, buffer solutions, saline solutions, solutions containing electrolytes or other chemicals needed either for chemical reactions at the electrodes or for other electrode preparations, and mixtures thereof.

The several sensor run-in preparations described herein may or may not completely prepare a sensor for use. However, the sensor will be closer to an operational state than if the run-in preparations did not occur. When a glucose sensor, for example, is in use, hydrogen peroxide is produced in the presence of glucose at the electrode, the hydrogen peroxide is converted to electrons, and the electrons are measured at the working electrode. When a glucose sensor is first exposed to glucose there is a lag time before electrons are produced at a steady-state indicating the glucose level. After a steady-state is obtained, if voltage is discontinued to the electrodes, the sensor depolarizes, i.e., electrons are no longer attracted to the working electrode, but the reaction to form hydrogen peroxide still occurs. Thus, when a potential is again applied to the electrodes the excess hydrogen peroxide needs to be converted and the measurement from the sensor will appear higher than the actual glucose level. In both the start up and restart scenarios, the sensor takes some time to equilibrate and provide a steady-state reading indicative of the glucose level.

Also provided herein, are apparatus for stabilizing a sensor that is being prepared for use, e.g., during initial implantation, or already in use. These apparatus include a circuit connectable to a sensor for providing a signal, such as an electrical current or potential, to the sensor. Such a signal can include, for example, a constant or periodic potential applied to a reference electrode **12** and/or a working electrode **16** such as those shown in FIG. **3**. The signal chosen to be sent to the sensor is one that prevents the sensor from becoming destabilized prior to being connected or upon being disconnected from a monitoring device. For example, the circuit can prevent the sensor from becoming depolarized. When the electrodes of a sensor become depolarized the sensor cannot be used immediately and another run-in period becomes necessary to repolarize the electrodes. A glucose sensor, for example, has a chemical component to maintain a stabilized state, i.e., if a glucose sensor is in the presence of glucose,

hydrogen peroxide conversion takes place and excess hydrogen peroxide will need to be converted prior to obtaining accurate glucose level readings. However, if the glucose sensor retains its electrical potential excess hydrogen peroxide does not accumulate at the working electrode.

As shown in FIG. **8**, a sensor **400** can be connected to a circuit **500** and a monitoring device **600**. FIG. **9** shows an alternative configuration in which the circuit **500** and monitoring device **600** are not connected to the sensor **400** in series, i.e., there are two possible connections to the sensor **400**. In either configuration, to stabilize a sensor **400**, i.e., maintain the sensor **400** in an active, useable state, a signal is continually provided to excite the sensor **400**. Maintaining a signal to excite the sensor **400** is accomplished by maintaining a connection with a power source, such as a power source from either the circuit **500** or monitoring device **600**. Alternatively, a signal to excite the sensor **400** is provided by another source, such as a battery of a charged capacitor communicating with the sensor **400**. As described above, the sensor **400** can be an electrochemical sensor such as a glucose sensor.

The circuit **500** can be configured to connect to a sensor **400** continuously such that the circuit **500** is connected to the sensor **400** both when the sensor **400** is connected to and when the sensor **400** is disconnected from a monitoring device **600**. Alternatively, a circuit **500** can be configured to be capable of being removed from the sensor **400** when the sensor **400** is connected to a monitoring device **600** or an alternate signal source and reconnected to the sensor **400** when the sensor **400** is to be disconnected from the monitoring device **600**, with the provision that a signal to excite the sensor **400** is continually applied to the sensor **400**. In a further alternative as shown in FIG. **10**, the sensor **400** and circuit **500** are integrated into a single unit. In an additional alternative, the sensor **400** and circuit **500** are integrated into a single unit that is disposable.

If the sensor **400** is connected to, for example, a patient monitoring cable **510**, the circuit **500** can either be integrated into the cable **510** so it is not removed when the sensor **400** is in use as shown in FIG. **11**, or the circuit **500** can be removeably connectable to the patient monitoring cable **510** as shown in FIG. **12**. If the circuit **500** is removeably connectable to a patient monitoring cable **510**, the monitoring device **600** to which the patient monitoring cable **510** is connected is capable of providing a signal to the sensor **400**. Then, when the patient monitoring cable **510** is to be disconnected from the monitoring device **600**, the circuit **500** provides a signal to the sensor **400** in the absence of the signal from the monitoring device **600**. When the circuit **500** is integrated into a device, such as a patient monitoring cable **510**, and the circuit **500** is not disconnected from the sensor **400** when the sensor **400** is connected to a monitoring device **600**, the circuit **500** can be configured such that there is a manual mechanism for disconnecting the circuit **500** from the sensor **400** or the circuit **500** can be configured to automatically disconnect in the presence of another signal source, e.g., a voltage source. Alternatively, when the sensor **400** is connected to the monitoring device **600**, the circuit **500** can continue to provide a signal to the sensor **400** with the monitoring device **600** providing power for the circuit **500** to operate or charging the power source of the circuit **500**. Such circuit aspects are easily designed and implemented by those of skill in the art.

As shown in FIG. **13**, circuits **500** such as those described can be housed in modules **520** to which a sensor **400** can be connected and which can be in turn connected in series to a monitoring device **600**. A monitoring device **600** can be configured to accept a module **520** containing a circuit **500**.

A circuit **500** can include a rechargeable voltage source, e.g., a rechargeable battery. The circuit **500** can be configured to recharge the rechargeable power source when the circuit is connected to a monitoring device. Alternately, the rechargeable power source can be charged or recharged at a charging station which can be used to initially charge a rechargeable voltage source connected to a circuit **500** or maintain a charge if a sensor **400** remains disconnected from a monitoring device **600** for an extended period of time. A recharging station can have multiple positions for simultaneously charging multiple circuits **500**.

As an additional feature, a recordable storage medium (not shown) can be included in the circuit **500**. The recordable storage medium, such as an electrically erasable programmable read-only memory (EEPROM), can, for example, record data corresponding to the sensor **400**. Data corresponding to the sensor **400** can include time data, such as total time in service or time since last connected to a monitoring device **600**, calibration data, or sensor reading or condition data. Such data can, for example, be recorded from sensor readings, internal timing devices, or other sensor **400** or circuit **500** generated data, or transferred to the circuit **500** prior to the sensor **400** being disconnected from a monitoring device **600**. Then, conversely, when the sensor **400** is connected to a different monitoring device **600**, some or all of the data can be transferred to the newly connected (or reconnected) monitoring device **600** to enable the new (or reconnected) monitoring device **600** to prepare the sensor **400** to begin collecting data, thereby reducing the needed run-in and/or calibration time. If a large enough memory capacity is available, all or many of the measurements made by a sensor **400** during a monitoring period could be stored in the circuit **500** for retrieval by a number of different monitors. Further features of the circuit **500** can include the ability to wirelessly transmit data to a monitoring device when a sensor **400** is detached from the monitoring device and the ability to log readings upon disconnect (either accidental or intentional) for transmittal to a monitoring device when reattached.

Circuits **500** such as those described can be housed in modules to which a sensor **400** can be connected and which can be in turn connected in series to a monitoring device **600**. Such a circuit **500** can also be integrated into a device containing a sensor **400**. A monitoring device **600** can be configured to accept a module containing a circuit **500**. Further, sensors **400** can, for example, be incorporated into devices including medical devices such as patient monitoring cables. Circuits **500** can be, for example, incorporated into devices incorporating sensors or devices designed to connect to sensors. Where a storage capacitor is used as a signal source as described above, it can also be incorporated into devices in the same manner as the circuit **500**.

The present invention is not limited in scope by the embodiments disclosed herein which are intended as illustrations of a few aspects of the invention and any embodiments which are functionally equivalent are within the scope of this invention. Various modifications of the apparatus and methods in addition to those shown and described herein will become apparent to those skilled in the art and are intended to fall within the scope of the appended claims. Further, while only certain representative combinations of the apparatus and method steps disclosed herein are specifically discussed in the embodiments above, other combinations of the apparatus components and method steps will become apparent to those skilled in the art and also are intended to fall within the scope of the appended claims. Thus a combination of components or steps may be explicitly mentioned herein; however, other combinations of components and steps are included, even

though not explicitly stated. The term "comprising" and variations thereof as used herein is used synonymously with the term "including" and variations thereof and are open, non-limiting terms.

What is claimed is:

1. A method of preparing a sensor for use comprising:

providing an electrolyte solution to a sterilized packaging containing

an electrochemical glucose sensor connected to a sensor activating circuit without compromising the sterilized packaging, the electrochemical glucose sensor comprising a working electrode and a glucose oxidase containing reagent layer covered by a glucose selective membrane configured to react with glucose to provide hydrogen peroxide about the electrode;

activating the sensor activating circuit; and

allowing the electrochemical glucose sensor reagent layer to stabilize, with respect to polarization, in the electrolyte solution.

2. The method of claim **1**, wherein the electrochemical glucose sensor is prevented from depolarizing.

3. The method of claim **1**, wherein the electrolyte solution is provided via a resealable port in the sterilized packaging.

4. The method of claim **1**, wherein the electrolyte solution is provided via a rupturable solution container.

5. The method of claim **1**, wherein the circuit is activated when the electrolyte solution is provided.

6. The method of claim **1**, further comprising the steps of:

connecting or disconnecting the electrochemical glucose sensor to a monitoring device;

wherein the circuit provides a signal to the electrochemical glucose sensor that prevents the electrochemical glucose sensor from becoming destabilized when connected or disconnected from the monitoring device.

7. The method of claim **6**, wherein the signal is one of a continuous or a periodic electrical potential or a continuous or a periodic electrical current.

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